

## NATURAL RESOURCES CONSERVATION SERVICE

### CONSERVATION PRACTICE STANDARD

## UNDERGROUND OUTLET

(Feet)

CODE 620

### DEFINITION

A conduit or system of conduits installed beneath the surface of the ground to convey surface water to a suitable outlet.

### PURPOSE

To carry water to a suitable outlet from terraces, water and sediment control basins, diversions, waterways, surface drains or other similar practices without causing damage by erosion or flooding.

### CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- Disposal of surface water is necessary.
- An outlet is needed for a terrace, diversion, water and sediment control basin or similar practice but a surface outlet is impractical because of stability problems, topography, climatic conditions, land use or equipment traffic.
- The site is suitable for an underground outlet.

### CRITERIA

Plan, design and construct all underground outlets to comply with all Federal, State and local laws and regulations.

**Capacity.** The design capacity of the underground outlet is based on requirements of the structure or practice it serves. The underground outlet can be designed to function as the only outlet for a structure or it

can be designed to function with other types of outlets. The capacity of the underground outlet for natural or constructed basins shall be adequate for the intended purpose without causing inundation damage to crops, vegetation, or works of improvements.

Underground outlets may be designed for either pressure or gravity flow. If a pressure system is designed, all pipe and joints must be adequate to withstand the design pressure, including surges and vacuum. To fully utilize conduit capacity, design the inlet to provide maximum flow in the conduit. To prevent pressure flow or overloading of the conduit a flow restricting device such as an orifice or weir can be used to limit flow into the conduit.

If there are multiple structures flowing into an underground outlet, design the system so that upstream structures do not discharge into downstream structures unless the downstream structure is designed to accommodate the extra flow.

Pressure-relief wells (open stand pipes) may be used to allow excess flow to escape the conduit and flow over the surface. Only use pressure relief wells where there is a stable outlet for the flow from the relief well. Cover pressure relief wells with a grate or other appropriate covering to prevent the entry of small animals and debris.

**Inlet.** An inlet can be a collection box, a perforated riser, or other appropriate device. For perforated risers, use durable, structurally sound material that is resistant to damage by rodents or other animals. Use fire resistant materials for the inlet if fire is an expected hazard. Riser inlets shall be sized using applicable weir or orifice formulas; however, the riser shall be not less than 6-inch diameter.

Inlets must have an appropriate trash guard to ensure that trash or other debris entering the inlet passes through the conduit without plugging.

Design collection boxes large enough to allow maintenance and cleaning operations. Use blind inlets where the installation of an open or above ground structure is impractical. Design the blind inlet with a graded granular filter around the conduit. Design the filter based on the particle size of the surrounding soil and the desired flow rate.

Blind inlets can be used where they are effective. The use of gravel inlets is limited to level terraces and water and sediment control basins storing the 10-year frequency runoff and to sites where open structures will severely hamper normal farming operations. The minimum surface area for gravel inlets shall be 3 feet by 5 feet. When the volume of water to be discharged per 48 hours exceeds 30,000 cubic feet, the gravel surface shall be increased at least 5 square feet for each additional 10,000 cubic feet of water to be discharged. Refer to NEH Part 650, Engineering Field Handbook, Chapter 14 for the design of blind inlets.

Table 1 - PIPE LENGTH per 0.1 cfs

| Area of Slots<br>Per Linear<br>Foot of Pipe | Rectangular<br>Slots | Round Slots |
|---|----------------------|-------------|
| 1 inch <sup>2</sup>                         | 5 Ft                 | 10 Ft       |
| 2 inch <sup>2</sup>                         | 2.5 Ft               | 5 Ft        |
| 3 inch <sup>2</sup>                         | --                   | 3.5 Ft      |

The minimum length of perforated pipe within the gravel filter for each 0.1 cfs of required pipeline capacity shall be as shown in Table 1. In lieu of using this criteria the size of the gravel filter can be designed using Darcy's equation and the pipe length designed using criteria in Appendix A of NRCS, Soil Mechanics Note 3. Gravel for the inlets shall be in the range of 1/4 inch to one-inch diameter. Gravel meeting the gradation requirements of ASTM C33 for designations 3, 357, 4 and 5 is acceptable.

On irrigation tailwater underground outlets, the individual risers can be designed for a portion of the total system design capacity. The individual riser design flow will depend upon riser spacing. Riser spacing shall be based on the sideslope of the field as follows:

| Slope<br>%    | Maximum Riser Spacing<br>Feet |
|---------------|-------------------------------|
| 1-<3          | 50-60                         |
| 3 and greater | 30-40                         |

Small embankments shall be constructed between the risers to provide basins for ponding and sediment accumulation. The embankment height shall be a minimum of 6 inches above the design water height of the basin. The design water height is defined as the water surface height with the riser pipe flowing at design capacity. Embankments shall have a minimum 2-foot top width at the design water height elevation and sideslopes of 2 to 1 or flatter.

**Conduit.** Underground outlets shall be conduits of tubing, tile or pipe. The minimum allowable conduit diameter is 4 inches. Design hydraulically smooth joints using materials and methods recommended by the manufacturer of the conduit.

The maximum design velocity must not exceed the safe velocity for the conduit materials and installation according to the conduit manufacturer's recommendation. Refer to Conservation Practice 606, Subsurface Drainage for design criteria for safe velocity.

If junction boxes and other structures are needed, design them to allow cleaning and other maintenance activities. Maintain a downward grade towards the outlet in all sections of the underground outlet.

**Materials.** Plastic, concrete, aluminum, and steel pipe shall meet the requirements specified in the applicable ASTM standard. All materials specified in Conservation Practice Standard (606), Subsurface Drains can be used for underground outlets. Materials must meet applicable site specific design requirements for leakage, external loading, internal pressure or vacuum.

Underground outlet conduits can be perforated or nonperforated, depending on the design requirements. Use a filter fabric wrap (sock) or appropriately designed granular filter if migration of soil particles into the conduit is anticipated. Design the filter based on the particle size of the surrounding soil to prevent rapid clogging of the filter. Refer to Conservation Practice 606, Subsurface Drainage for criteria for the design of filter media. Protect all exposed plastic materials from degradation due to exposure to sunlight.

**Depth.** Depth of cover shall be a minimum of 2 feet, however less depth of cover may be allowed for short distances at the outlet when necessary to provide adequate outlet conditions. Consider the depth of tillage and surface loads as applicable.

**Outlet.** The outlet must be stable for anticipated design flow conditions from the underground outlet. Design the underground outlet for water surface conditions at the outlet expected during the design flow conditions.

The outlet must consist of a continuous 10 foot section or longer of closed conduit or a headwall at the outlet. If a closed conduit is used, the material must be durable and strong enough to withstand anticipated loads, including those caused by ice. Do not design outlets to be placed in areas of active erosion. Use fire resistant materials if fire is an expected hazard. All outlets must have animal guards to prevent the entry of rodents or other animals. Design animal guards to allow passage of debris while blocking the entry of animals that cannot easily escape from the conduit.

**Stabilization.** Reshape and regrade all disturbed areas so that they blend with the surrounding land features and conditions. Revegetate or otherwise protect from erosion, disturbed areas that will not be farmed, as soon as possible after construction.

## CONSIDERATIONS

Pressure relief wells, if not properly covered, can present a safe hazard for people or animals stepping into the well. In addition, pressure relief wells can be easily damaged by

field equipment. To prevent accidents mark the location of pressure relief wells with a high visibility marker.

The rapid removal of water through an underground outlet will affect the water budget where it is installed. It can reduce infiltration. It can increase or decrease peak flows to receiving waters and reduce long term flows into the same waters. Consider these long term environmental, social, and economic effects when making design decisions for the underground outlet and the structure or practice it serves.

If perforated pipe is used for the subsurface conduit, locate the practice so that it has a minimal effect to the hydrology of wetlands.

To prevent sediment from collecting in the conduit, underground outlets should be designed with a minimum velocity of 1.4 ft/sec.

Where perforated risers are used, often the risers are perforated below the surface of the ground to facilitate drainage. In this situation, if soil entry into the riser perforations is a problem, use an appropriately designed gravel or geotextile filter around the buried portion of the riser.

Seasonal water sources can be very important for migratory waterfowl and other wildlife. The use of a water control structure, on the inlet of an underground outlet during non-cropping times of the year, can allow water to pond in the structure to provide water for wildlife. Refer to Conservation Practice Standard (646) Shallow Water Development and Management for information on managing seasonal water sources for wildlife.

Underground outlets can provide a direct conduit to receiving waters for contaminated runoff from crop land. Underground outlets and the accompanying structure or practice should be installed as part of a conservation system that addresses issues such as nutrient and pest management, residue management and filter areas.

The construction of an underground outlet in a riparian corridor can have an adverse affect on the visual resources of the corridor. Consider the visual quality of the riparian area when designing the underground outlet.

The construction of an underground outlet can disturb large areas and potentially affect cultural resources. Be sure to follow state cultural resource protection policies before construction begins.

If an installation in a crop field is too shallow, tillage equipment can damage an underground outlet. Consider the type and depth of tillage that will likely occur when designing the depth of an underground outlet. A minimum of 2 feet of cover is recommended over all conduits.

### **PLANS AND SPECIFICATIONS**

Prepare plans and specifications for underground outlets that describe the requirements for applying this practice according to this standard. The plans and specifications for an underground outlet may be incorporated into the plans and specifications for the structure or practice it serves. As a minimum the plans and specifications shall include:

1. A plan view of the layout of the underground outlet.
2. Typical cross sections or bedding requirements for the underground outlet.
3. Profile of the underground outlet.
4. Details of the inlet and outlet.
5. Seeding requirements if needed.
6. Construction specifications that describe in writing the site specific installation requirements of the underground outlet.

### **OPERATION AND MAINTENANCE**

Prepare an operation and maintenance plan for the operator. The minimum requirements to be addressed in a written operation and maintenance plan are:

- Periodic inspections, especially immediately following significant runoff events, to keeping inlets, trash guards, and collection boxes and structures clean and free of materials that can reduce flow.

- Prompt repair or replacement of damaged components.
- Repair or replacement of inlets damaged by farm equipment.
- Repair of leaks and broken or crushed lines to insure proper functioning of the conduit.
- Periodic checking of the outlet and animal guards to ensure proper functioning.
- Repair of eroded areas at the pipe outlet.
- Maintenance of adequate backfill over the conduit.
- To maintain the permeability of surface materials on blind inlets, periodic scouring or removal and replacement of the surface soil layer may be necessary.

### **REFERENCES**

National Engineering Handbook, Part 650  
Engineering Field Handbook, Chapters 6, Structures; Chapter 8, Terraces; and Chapter 14, Drainage, USDA Natural Resources Conservation Service.